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ABSTRACT

As part of a project that identified the specific literacy skills required in ten occupations, this report provides two levels of instructional information about welders. Factual data are presented in Parts I and II for use in decision making by program developers, administrators, teachers, and counselors. These sections note the specific literacy requirements (reading, writing, listening, speaking, and mathematics) that were identified at three job sites and in three vocational training programs. Part III presents instructional methods/materials that adult basic education teachers can use to develop literacy skills while imparting job related knowledge. The lesson format is based on a directed reading activity and includes vocabulary and concept development, sentence and organizational structure, silent reading, and skill development. Appendixes list the technical vocabulary that welders need to know, the 100 words that represent 45% of the language sampled for the entire project, and occupational literacy requirements for the ten occupations that were studied. (AEA)

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THE LITERACY REQUIREMENTS OF A WELDER ON THE JOB AND IN A VOCATIONAL TRAINING PROGRAM

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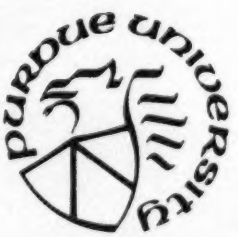

January 1980

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* * *

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PROJECT ABSTRACT

THE IDENTIFICATION OF LITERACY REQUIREMENTS OF JOBS IN INDUSTRY AND CORRESPONDING VOCATIONAL TRAINING PROGRAMS

1.	Need Addressed:	Meeting the educational needs of adults with minimal literacy skills who wish to enter skilled or semi-skilled occupations.
2.	Population Served:	Adults with minimal literacy skills.
3.	Brief Description:	Specific literacy requirements (reading, writing, listening, speaking, and mathematics) of semi-skilled and skilled occupations in business, industry and vocational training programs were determined. The literacy demands of three work contexts and training programs for each of the ten occupations were analyzed and reported.
4.	Major Objectives:	To provide educators, counselors, and administrators with a description of the literacy requirements of semi-skilled and skilled occupations and training programs to which functionally illiterate adults aspire.
5.	Products:	A description of the literacy requirements necessary to hold a job in each of ten occupations and the corresponding requirements necessary to succeed in vocational training programs which prepare individuals for each of those occupations is provided. A booklet for each of the ten jobs was prepared.

INTRODUCTION

This project was undertaken in response to a need, expressed by adult basic educators and counselors, for information about the specific literacy skills necessary for success in several occupations. The occupations studied had been identified as desirable careers during informal interviews with adults who were enrolled in basic education programs in the Lafayette, Indiana area. Employment counselors and officials of the Office of Career Development confirmed that the occupations identified for study were appropriate. Because Greater Lafayette offers a wide range of occupational and training opportunities, the project staff was able to study both job sites and vocational training sites for each of the following occupations: account clerk, automotive mechanic, draftsman, electrician, heating and air conditioning mechanic, industrial maintenance mechanic, licensed practical nurse, machine tool operator, secretary, and welder.

Purpose and Audience

This report provides descriptive and instructional information to adult educators at two levels. Factual data are presented in Parts I and II for use in decision making by program developers, administrators, lead teachers, and counselors. Part III presents instructional methods and materials and is meant for use by adult basic education teachers. Members of both groups may be interested in the entire report, but in preparing it the project staff attempted to address the needs of the two audiences separately.

Procedures

To identify reading, writing, speaking, listening, mathematics, and other characteristics which are necessary for success both on the job and in the training program, three job sites and three vocational college courses were studied.

Required reading materials from each of the six settings were evaluated using two widely used readability formulas, the Dale-Chall Formula and the Fry Readability Graph. Readability estimates were computer assisted. A minimum 2000 word sample of written language was taken from each site. Special considerations and problems related to reading the technical materials were identified, and the relative use of reading as a work tool and as a learning tool was determined.

To identify speaking and listening requirements, one hour samples of oral language were recorded at each job site and in each vocational college course. Language recorded at each site was rated for its technical and formal qualities, and computer-analyzed to assess vocabulary and syntax. Written and oral language samples were used to develop the Key Technical Vocabulary List found in Appendix A. The combined language samples from all occupations studied were used to develop the Highest Frequency Word List found in Appendix B. A summary of the literacy requirements for all ten occupations studied is found in Appendix C.

Writing samples were obtained at each of the six sites and used to determine the nature of written communication demands on the job and in the vocational training program.

Mathematics demands were determined through surveys of materials from the job sites and classrooms. Instructors and supervisors

responded to a questionnaire about the specific mathematics skills necessary for job and/or training program success.

Important non-literacy characteristics were identified by supervisors who completed a rating scale which asked for their estimate of the importance to job success of such factors as cooperativeness, reliability, and attitude toward work.

The following sections of this report are organized according to the requirements of the job, the requirements of the training program, and instructional recommendations.

PART I

REQUIREMENTS ON THE JOB

Job Sites Studied

At each of three separate job sites, the literacy demands placed on one successful welder were studied. Reading, writing, oral language, and mathematics were the specific literacy skill areas examined. Welders from three shops of distinctly varying sizes cooperated in the survey. From each job site, examples of the reading, writing, and mathematics tasks done on the job were obtained. Samples of the oral language requirements of the jobs were obtained by tape recording a randomly chosen one hour period of on-the-job verbal interaction. At each job site, the welder's immediate supervisor completed a questionnaire which was concerned with the importance of thirteen worker characteristics. Supervisors were also asked to identify the mathematics skills necessary for job success and to estimate the amount of time per week that welders spent on mathematics-related work.

Reading Requirements

Strong reading skills are not considered to be an essential aspect of welding. Supervisor estimates of the amount of on-the-job time involving reading indicated that less than ten percent of a welder's time is devoted to reading tasks.

Very few reading materials were found at the job site. Welders and their supervisors, however, emphasized the importance of the ability to read blueprints. The blueprints generally contained only a few words, such as size, length, use, and total. Because of the scarcity of required reading materials on the job, readability estimates of job site materials were not determined.

Frequent task repetition and familiarity with specialized technical vocabulary may offset the apparent difficulty of any on-the-job reading requirements.

Uses of Reading on the Job

Each welder who participated in the project completed questionnaires concerning the use of reading in three separate job-related tasks. The questionnaire results showed that when reading was done on the job, it was used primarily as a tool for accomplishing work. Blueprints were interpreted for each daily welding job. The few work texts reported by the welders, a book of steel charts and a guide for choosing rods, were checked on occasion to perform an unfamiliar task. Overall, the few reading tasks on the job site were used to accomplish work correctly.

Writing Requirements

Grammatically correct writing skills were not essential for welders on the job. Supervisors rated the ability to communicate in writing as the least desirable quality of a welder. If writing was involved on the job, it tended to be one- or two-word descriptions of work accomplished.

Mathematics Requirements

Supervisors varied in their judgment of mathematics skills required by a welder on the job. The estimates ranged from a maximum of simple measurement ability to that of skills in fraction conversion and use of the decimal system. It can be assumed that basic arithmetic processes (addition, subtraction, multiplication, and division) and knowledge of measurement are common requirements for most welding jobs.

Scales on welding equipment and measurement symbols on blueprints were encountered by most welders daily.

Oral Language Requirements

The oral language samples collected on the three job sites were largely informal in nature. Conversation was casual and often not job-related. At times, however, discussions focused on the specific problem or object with which the welder was working. In this case, language was heavily weighted with technical vocabulary. Example I demonstrates a typical technical interaction.

EXAMPLE I

On-the-job Technical Language

"Do you think it's the air hole or do you think it's the valve? That other handle is not in there, is it? Is the forex nipple there under the coupling?"

Supervisors also emphasized the importance of the ability to follow spoken directions concerning a welding task.

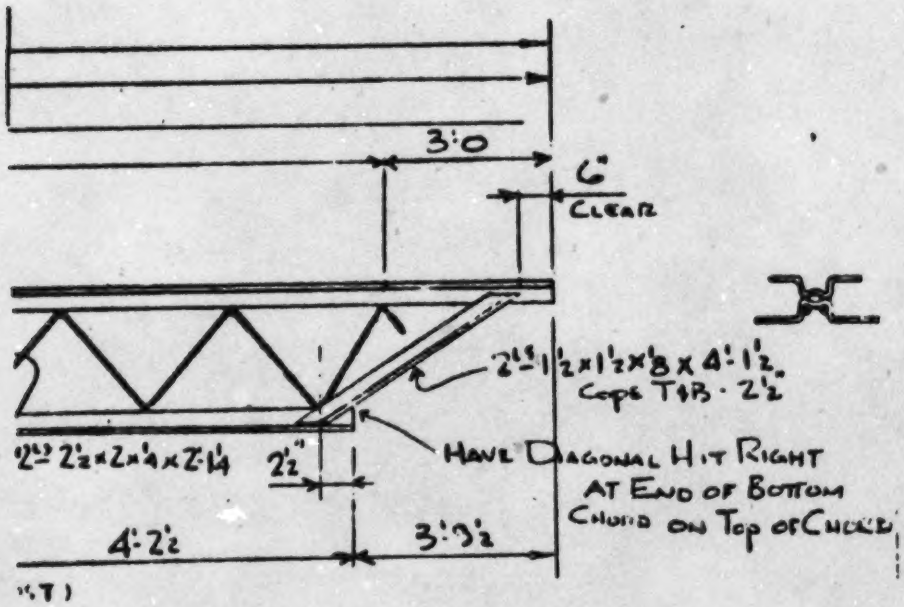
Special Considerations and Problems

As mentioned previously, the welders surveyed in the study relied

heavily on blueprints to accomplish daily welding tasks. These blueprints contained welding symbols, measurement indications, and single words or phrases describing the components of the welding job. Inability to interpret these blueprints, many of them highly complicated, would result in failure to complete a job or the inaccurate completion of a job. Example II illustrates the graphic nature of the material.

EXAMPLE II

Graphic Material



(Blueprint)

Key Non-Literacy Requirements

Supervisor ratings of requirements important to job success brought out the following important non-literacy characteristics: cooperation with fellow employees, job knowledge, good attendance, and ability to follow spoken directions. Each of these characteristics was rated as high or higher than reading and mathematics abilities.

PART II

REQUIREMENTS OF THE VOCATIONAL TRAINING PROGRAM

Courses Studied

The reading, writing, oral language, and mathematics requirements of three courses in a post-secondary vocational college welding training program were studied. The courses, Arc Welding, Electrical Fundamentals, and Gas Fusion Welding, had been determined by their instructors and the school administration to be representative of the training program as a whole. The literacy demands placed on students in other welding courses are approximately the same as those presented here. Practical experience was a large part of each course studied. Students participated in laboratory exercises designed to practice the skills and concepts presented through lectures and reading. This concrete practical experience may reduce the apparent demands of the training program.

Reading Requirements

Because of the need to present large quantities of information in a limited period of time, training programs typically have greater literacy demands than do the occupations to which they correspond. Lectures and written materials are used in place of first-hand experience

and more personalized supervision occurring at the job site.

Reading materials including textbooks, workbooks, and examinations were studied and rated according to the style in which they were written. The rating scale included informal, formal, literary, and technical levels. The materials surveyed in the welding training program were written in technical style such as that illustrated in Example III.

EXAMPLE III

Technical Writing Style

> "The electric induction furnace is essentially a transformer with the molten metal acting as the core. It consists of a crucible, usually made of magnesia, surrounded by a layer of tamped-in magnesia refractory. Around this is a coil made of copper tubing." (Sacks, 1976, p. 63)

The level of difficulty of the reading materials required in the course studied was determined by computer analysis using two widely accepted readability formulas. The Dale-Chall Formula and the Fry Readability Graph provided estimates of the general level of reading ability required for comprehension of the materials. Because the estimates of the two formulas were not identical, the estimates of readability for the three courses are presented as ranges of difficulty below.

READABILITY ESTIMATES

Course One	10th Grade to college graduate level
Course Two	11th Grade to college graduate level
Course Three	8th Grade to college graduate level

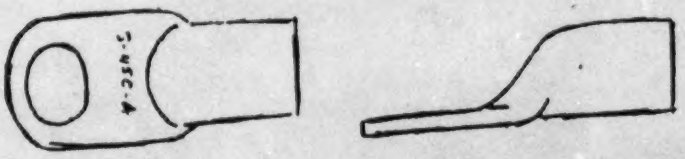
Readability estimates do not account for factors such as knowledge of a specialized vocabulary, as in the case of reading blueprints, nor do they take into account reader motivation. Such factors are known to affect reader success in mastering difficult material.

Special Reading Considerations and Problems

The written materials used in the welding courses made extensive use of tables, figures, and illustration. Instructions and routines were presented in lists of steps which had to be interpreted and followed. Example IV illustrates the use of figures and illustration.

EXAMPLE IV

Use of Figures and Illustration



(Electrode and ground cable)

Example V presents a sequence of steps to be followed in completing a welding task.

EXAMPLE V

Listed Steps in Accomplishing a Task

1. Shut off torch by shutting off acetylene torch valve, then shutting off oxygen torch valve.
2. Shut off both oxygen and acetylene cylinder valves.
3. Bleed gas lines. Open the acetylene torch valve. Close when pressure is released. Repeat with oxygen torch valve.

Uses of Reading

In welding training, reading is used both as a tool for accomplishing work and as a learning tool. Laboratory exercises resembling on-the-job welding tasks are done on a regular basis. When reading directions or diagrams, reading to do is implemented. When studying is required, reading to learn is used. Instructional techniques related to both reading to do and reading to learn are found in Part III of this report.

Writing Requirements

The ability to communicate important information through writing was necessary in the welding training program. Standard grammatical conventions, however, were not required. Answers presented in legible short-answer form were acceptable. An example of a written response is included in Example VI.

EXAMPLE VI

Student Written Response

Question: What is the function of a regulator?

Answer: Controls gas flow.

Tasks such as this found in workbook exercises are relevant to instruction but may have little resemblance to on-the-job tasks.

Mathematics Requirements

Welding instructors defined skill in the basic arithmetic processes of addition, subtraction, multiplication, and division as being required. Work with fractions, the decimal system, measurement, word problems, and geometrical problems was also a requirement of the training program. Some knowledge of algebra was rated as being desirable. Despite the broad knowledge of mathematics required, the instructors estimated that their students spent twice as much time on reading tasks as they did on mathematics-related tasks.

Oral Language Requirements

Oral language used in welding training programs was usually informal, but much technical information and vocabulary was involved. An excerpt from an instructor's technical conversation with a student is presented in Example VII.

EXAMPLE VII

Technical Oral Language

A. Instructor: "In this case, we put the coil around the pole piece so we make a magnetic field in the pole piece to run electricity through the coil. We're putting AC into this coil so that the coil is going to change directions from time to time as the AC changes. We then put a coil of wire in here on an iron core."

B. Instructor: "All AC motors are fixed rpm based on the number of poles and frequency. Well, we get some states involved such as frictional losses and such. A true synchronous motor will be a pole multiple of the power line frequency. So, for instance, a common synchronous motor speed is 1800 rpm's."

Listening and note taking were important skills for the students in the training program. Students were expected to find and refer to specific pages and figures in textbooks to accomplish certain tasks. Students were also expected to carry out tasks by listening to oral directions given by instructors.

The styles of English observed in the training program were similar to those found on the job. Job tasks required the ability to follow oral directions.

PART III

INSTRUCTIONAL RECOMMENDATIONS

Project Overview

The vocational training program required a generally high literacy level in both reading and mathematics. The job site, in contrast, required little use of reading and higher level mathematics skills, implementing technical skills unique to the occupation. These skills included interpretation of blueprints and knowledge of welding equipment.

In the training program, the estimated readability of required materials extended from eighth grade to college graduate level. It was noted in previous sections of this report that knowledge of key technical concepts and vocabulary, combined with familiarity gained through daily use of reading materials, may reduce the perceived difficulty of reading tasks.

In the vocational training program, reading was used most often as a learning tool. Reading-to-do tasks, however, which were similar to on-the-job tasks, occurred frequently.

Writing requirements for the training program included the ability to respond to written questions in single words or phrases. The welders on the job, however, rarely made use of writing skills of any kind.

Basic arithmetic skills were necessary at both the job site and in the training program. Measurement skills were required to perform most welding tasks.

A brief summary of how the literacy requirements of the welder compare to those of the other nine occupations studied is found in Appendix C.

Organization of ABE Lessons

The recommendations which follow are meant to aid teachers and tutors in designing lessons which develop literacy skills while imparting job-related knowledge. Reading demands were found to be high in the welding training program. Reading skills were needed to accomplish tasks similar to those done on the job.

This section, therefore, presents background information and a method of organizing ABE lessons which emphasizes reading. Background information provided deals with the teaching of vocabulary and teaching about text structure and organization. The lesson format is based on a directed reading activity (DRA) and includes vocabulary and concept development, sentence and organizational text structure, silent reading, and skill development.

The guiding principle of a DRA method of lesson organization is that words, concepts, and skills must be introduced and practiced in situations and materials that are true to life. For example, words, sentences, tables, and illustrations should be similar to those used on the job or in the training program. It may be possible to teach an interested ABE student the words on the Key Technical Vocabulary List in isolation, but

it is a far better practice to introduce and practice such words in contexts such as those found in occupational reading materials. There may be a wide gap between the reading requirements of occupational materials and the reading abilities of the student. If possible, materials which parallel those found on the job and in the training program can be developed by teachers and tutors. Through paraphrasing sections of textbooks, reference books and manuals, the readability of occupational materials can be reduced so that literacy skills and job-related knowledge can be developed simultaneously.

The value of a DRA approach is that it allows the use of any appropriate reading material in a job-related reading skill development program.

Notes on Teaching Vocabulary

The specialized vocabularies of welders contain many key concepts and words which are common to the welding occupation in general.

The specialized technical words of the Key Technical Vocabulary List could be taught to ABE students interested in entering the welding field so that both the words and their meanings are recognized. This implies that the words will be taught in a meaningful context.

It is important for ABE students to be introduced to common high-frequency words and specialized vocabulary words via contexts which are similar to those found on the job and in the training program. As noted previously, this practice develops basic job-related knowledge and reading ability.

The following are suggestions for teaching vocabulary:

1. Pair the word to be taught with the concept or object that it refers to whenever possible.
2. Introduce the word using an approach which focuses student attention on the word.
3. Be sure that the new word is read in context very soon after it has been taught.
4. If in doubt, use the general rule that four to six new words per lesson be introduced. Learning and recall are typically most efficient when the number of words taught is in this range.
5. Review vocabulary words frequently.

Sources of job-related vocabulary words and concepts are included in the books cited in the bibliography of this report. The style and level of writing in the listed materials is often highly technical, thus, some teacher time could be devoted to preparing lower readability materials which parallel high-level passages.

Notes on Teaching About the Structure and Organization of Text

The above suggestions on teaching vocabulary words emphasize meaning; words have little use outside of a meaningful context. In the field of welding even solitary words on a chart or diagram have a meaningful context to a trained individual.

In reading, it is important to be aware of special patterns of organization used by writers. Formal technical reading materials are

organized differently from the short stories and novels used in teaching reading to most Americans. The expository style of writing used in textbooks and other specialized or technical materials is different from the narrative style of stories and novels at several levels of comparison.

At the sentence level, ABE students should learn that expository style often relates cause and effect. Sometimes this relationship is clearly stated as in the sentence in Example IX-A.

EXAMPLE IX

Stated and Unstated Cause and Effect Relationship

A. The joint separated because of a poor spot weld.

B. The spot weld was done improperly. The joint separated.

Often, however, the relationship is not stated, as in Example IX-B. In such cases, readers who are not expecting cause and effect connections may miss them.

At the paragraph level, writers of expository material often use a format which states the main idea in the first sentence. The last sentence summarizes the paragraph and may connect it to a paragraph that follows. Comprehension and learning can be improved when readers are aware of this organizational technique.

At the chapter level, expository material may contain many valuable aids to efficient reading. Key words are used as headings which introduced important sections. Pictures, diagrams, tables, and figures are used to illustrate important ideas. Introductions and chapter summaries are also available as aids to readers who know how to use them.

ABE students should learn about style factors such as these and use them to enhance comprehension. Efficient readers use their knowledge of expository style to organize their reading. Awareness of the use of cause and effect makes them sensitive to such relationships. Knowledge of paragraph and chapter organization is used to develop a 'mind set' which is helpful in organizing and remembering important information. Reader-composed questions based on paragraph lead-sentences, headings, pictures, and other graphic aids help readers organize, comprehend and remember what is read.

A directed reading activity, described in the next section, is a system which enables the ABE student to become efficient in using organizational factors as aids to comprehension and memory.

Directed Reading Activity

This system of preparing for efficient reading may be used with individual students or with groups. In groups, it requires very little class time to prepare students for reading assignments. For both individual and group use, it has been demonstrated to increase reading efficiency and comprehension.

After a review of previously taught, related concepts and assignments, follow the below procedures:

I. Develop Readiness for Reading the Assignment

Purpose: Motivate
Set purposes for reading
Develop vocabulary

Teacher role: Ask Questions -

How familiar is the subject matter and vocabulary to your student?

Teach New Vocabulary -

Be concrete: write out the words as you introduce them. Use examples, such as objects or pictures, point out word relationships. Have students write the words as they are taught.

Ask Questions to Stimulate Interest -

Focus on titles, pictures, graphs.
Relate an anecdote from your own experience or one your students might have had.

II. Direct the Silent Reading of the Assignment

Develop questions from sub-headings, graphs, pictures, and tables. Try to focus on relationships in the assignment. Useful questions are often provided by textbook authors.

Have pupils read silently from 5 to 20 minutes to find the answers (keeping questions in mind as they read).

Encourage students to ask for help when they are confused. Writing questions down in abbreviated form is a good practice when reading is done outside of class.

III. Discuss Student Answers to Questions

Do not restate the questions unless necessary. Students need to remember the questions or they lose the purpose for reading.

Ask higher level questions to develop comprehension (have student(s) interpret, draw conclusions, and make inferences as well as recall facts).

IV. Reread as Necessary

When answers demonstrate confusion, have the student reread the appropriate small section to determine the reason for the confusion.

V. Follow-up and Skill Development

Confusion or lack of comprehension may signal a need for extra work on vocabulary, concept building, or word recognition skill.

In this phase of the lesson, other important skills such as mathematics can be related concretely to the reading assignment.

REMEMBER:

A DRA is a system, a routine, that you want your student(s) to learn to use independently. Remind your students of this - tell them why you use a DRA system. It will help them in their future study.

Reading to Accomplish Work

The term, reading to do, has been used in research and development projects done for the U.S. armed forces (Sticht, et al., 1977). Reading to do refers to the use of reading for the purpose of getting work done. It involves following written directions and reading to find information which will be used immediately. Such information need not be learned or remembered. Looking up telephone numbers; finding information in a policy manual; or finding important data in a table, chart, or figure, are examples of reading to do. Preparation of ABE students for reading-to-do tasks can be incorporated in a directed reading activity lesson.

When lesson materials contain occupationally relevant concepts, ABE students are given important background information which will make high-

er level training easier. Therefore, lessons should employ materials which are similar in structure and content to those found on the job or in the vocational training program. Paragraphs, tables, charts, and figures might be used verbatim from on-the-job or instructional materials. Alternatively, such materials might be paraphrased and reduced in difficulty to match student abilities.

Given appropriate materials and a period of orientation to them, the structural and organizational features of the table, chart, figure, paragraph, or chapter, should be pointed out to the student (see Notes on Teaching About Structure and Organization of Text). This is essentially the first step of the DRA described above. When the materials have been introduced, the student should be directed to find a particular fact in the material. In subsequent lessons, the difficulty of information-finding tasks should be increased.

Skill in following written directions can be developed using a DRA system and materials similar to Example X. Initial activities should contain only one or two steps.

EXAMPLE X

Written Directions

1. Listen to the directions on the Presentation Tape and execute those directions in Book I.
2. Do the Supplementary exercises for that lesson in Book II.
3. Complete the Self-Check for that lesson.
4. Take the information from the Dictation Tape for that lesson, reading back portions of it from your notes.

In information-finding lessons, the emphasis should be on understanding and careful identification of the required fact. Likewise, in lessons on following directions, understanding and careful execution of the required steps must be emphasized.

Reading to Learn Information

Skill in learning printed information for future use is very important in vocational training programs. The reading skills necessary for reading to learn (Sticht, et al., 1977) are taught and systematically practiced in directed reading activity lessons. That is, the use of previewing, attention to graphic and contextual information, and the organizational factors discussed in Notes on Teaching About the Structure and Organization of Text, above, should be practiced and learned during each DRA lesson. Questioning and rereading, also aspects of a DRA, reinforce important learning skills.

Sources of materials for use in reading-to-learn lessons, like those employed in reading-to-do lessons, should be occupationally oriented (See Bibliography). ABE students who receive reading instruction through job-related reading materials develop not only reading skills, but gain important job knowledge as well.

Counseling the ABE Student

ABE students should be made aware of the importance of reliability, cooperation, ability to follow directions, and other factors noted in Part I of this report. On the basis of the responses of supervisors surveyed in this study and previous research (Sticht, 1974), it seems that such characteristics contribute more to job success than do reading

and mathematics skills.

The literacy demands of the welding training program courses were high. It is, therefore, important that teachers, tutors, and counselors consider the facts presented earlier in this report, in addition to the individual students' levels of motivation and literacy skill development before beginning to prepare the student to enter a welding training program, either at a vocational college or on-the-job.

This does not mean that students with low literacy skills should be discouraged from preparing for a welding career. This report has indicated that higher level mathematics and reading skills are not necessarily required on the job. It does suggest, however, that an early and realistic estimate be made of the time and effort required to reach the goal of employment or, most specifically, formal training.

Summary

The literacy demands of welding training program courses were found to be more stringent than those required on the job. It is probable that individual experience and familiarity with specialized information reduces the perceived demands of training program tasks. The extent of such a reduction, however, is not know.

It was observed that vocational training programs for welding occupations provided students with tasks that were very similar to on-the-job tasks. Also, vocational program reading materials were shown to present important training concepts through texts which were more difficult than those found on the job.

Instructional recommendations in this report emphasized the develop-

ment of reading skills to aid those ABE students planning to enroll in a training program. Other literacy and non-literacy requirements were recognized as important, but it was clear at the training program sites studied that strong reading skills were important.

The recommended approach to ABE reading instruction was a directed reading activity (DRA), because it is systematic and provides for essential skill development and practice. Suggestions were presented on teaching vocabulary and the use of important structural and organizational factors which are related to comprehension.

Final recommendations sections focused on reading to accomplish work and reading to learn information. These two types of reading were discussed separately because they require different skills.

It was recommended that, in using the information and recommendations presented here, ABE teachers should be well acquainted with the occupational interests and motivation, as well as the literacy skills, of their students. The literacy requirements of welding training programs and specialized tasks on the job site are such that some students whose skills are well below those required may be unable to achieve sufficient skills in a reasonable period of time. Such students may choose to enter an on-the-job welding training program, or to alter their occupational goals.

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APPENDIX A

TECHNICAL VOCABULARY LIST

This list is based on the total oral and written samples of the language of welders both on the job and in the training program. Words included in the most frequent 1000 words of the Kucera-Francis list (based on adult language) have been deleted. The list was also edited to remove numberals; labels; names of people, places, products, and companies; contractions and possessives; and colloquialisms resulting from the oral language samples.

Some words included in the list are relatively uncommon words that occurred in the total language sample and are not necessarily technical terms. Thus, the list should be treated as a source rather than a criterion. The 91 most common words have been marked with an asterisk.

Total Sample Words = 13,687

Different Words = 2,375

abbreviate	airplanes	appreciation	backing	bit
absorbs	alignment	appropriate	backup	bite
ac*	allow	approved	balanced	blank
accessible	allowed	approximate	ballast	blooming
accidental	allowing	arc*	band	blow
accomplish	allows	arcing	bar	bobbin
accounts	alloys	argon*	bare	booklet
accumulate	alternating	armored	bars	boss
acetone	alternator	arrange	base*	bottom
acetylene*	aluminum	arrangement	bath	bought
acidic	ammeter	arrow	bathroom	box
acting	amounts	asbestos	battery	boxes
acts	ampere	associated	bead*	brass
actual	amperes	atmosphere	beads	braze
adapted	analyze	atmospheric	bearings	brazed
add	angle*	atomic	beat	brazing
address	angles	atrocious	becomes	break
adjust	animal	attach	begin	breaker
adjustment	anybody	attempt	beginner	breaking
advantage	anyplace	attempting	begins	breathe
advantages	anytime	attendance	believed	brick
advisable	anyway	attracted	bellhousing	bridge
affected	apart	authorities	bending	broken
affects	appearance	automatic	besides	bronze
afraid	appliances	avoid	bessemer	buddy
agree	application	avoided	beveled	build
agreed	apply	backfire	birds	buildup

built	carpet	charged	closer	composed
bulb	carries	charges	clothing	composition
burn*	carry	charging	coal	compound
burned	carrying	chart	coated	compounded
burning	carved	check	coating	compounds
burns	cassette	chemical	code	compress
burnt	cast	chemically	coil*	compressed
buttons	castings	chill	coils	compressor
buy	cat	chipping	coke	computer
buying	catch	choices	cokes	concentrate
buzz	category	cigarette	collect	condition
cable*	cathode	circuit*	colorless	conditioned
cables	cathodes	circuits	column	conditioning
cadmium	caused	circulate	combination	conduct
calcium	causes	citizen	combines	conductive
calibrated	causing	clamping	combining	conductor
calls	ceiling	clap	combustion	cone
cam	centerline	classes	comment	confined
canvas	centrifugal	classification	commercial	confused
capacitance	chain	clean	commonly	connect
capacitor*	chamber	cleaned	commutator	connected*
capacity	chances	cleaner	compare	connecting
carbide	chancing	clearance	compared	connection
carbon*	changed	cleats	comparison	connector
card	changing	clockwise	compensate	connectors
cards	chapter	clogged	completed	connects
careful	characteristic	closely	complicate	considerate

consistant
constant
constricted
constructed
construction
consumable
contact
contained
container
containing
contaminate
continuous
contour
contraction
controlled
controls
convention
conversation
cool
cooled
cooler
cools
copper*
cords
core
cored
correct*
correctly
coupling
cover
covers
crack
cracks
crane
crosses
crowbar
crowned
cubic
cuff
currently
custom
customary
cutting*
cycles
cylinder
cylinders
damage
damaged
damp
danger
dangerous
dc*
debt
decimal
deck
decrease
defective
definite
degrees*
demonstrate
densities
density
depend
dependent
depending
depends
deposit
deposited
deposition
depth
designer
desirable
desired
destroys
detail
develops
device
devices
dial
diameter
dielectric
diet
digging
digit
digits
dime
directed
directions
dirt
dirty
disadvantage
disappoint
discharges
disconnect
discrepency
discussed
discussing
discussion
disengaged
dissolved
dissolving
disturbed
divided
divisible
doors
double
downhill
downward
draftsman
drag
drawing
drawings
drill
drilled
drink
driving
drop
dropped
dry
ductility
dust
duty
ease
easier
eats
eavesdropping
economical
edge
edges
efficient
efficiently
eighty
eighteen*
eighteens
elbow

elbows
electric*
electrical
electrician
electricity
electrode*
electrodes*
electromagnet
electrons
electrostat
eleven
elevens
eliminates
employed
employer
encountered
ends
energized
energy
engine
engineering
engines
enjoy
enters
equal
equalized
equals
equivalent
essence
essential
essentially
establish
evenly
event
eventually
everybody
evident
evils
exactly
examples
exceed
excess
excessive
exert
exhaust
existing
exists
expansion
expense
explanatory
explosion
explosions
explosive
exposed
expressed
extend
extensively
external
extra
extreme
extremely
fabricating
facets
factor
failure
fairly
fashioned
fast
fastened
faster
fastest
fatal
fault
faults
feather
feature
features
fed
ferrous
fields
fifteen
fifth
fifty
fig.
figured
filler
fillet
finest
finger
fingers
finished
fires
fit
fitted
fittings
fixed
fixture
fixtures
flame*
flameout
flameoutting
flammable
flare
flashback
flat*
flax
flexible
flints
flow*
fluctuating
fluoride
flush
flux
fluxes
follow
follows
foot
forex
forged
formation
formed
formulate
forth
forty
fourfold
fours
fourth
fourway
fractional
fracture
freeze
freezers
frequency
frequently
friction

frictional	gloves	hang	Hobarts	inaccurate
fuel	goes*	happen	holder	inch*
fully	goggles	happening	holders	inches
fumes	gouging	happens	holds	includes
fun	grade	hardening	hole	inclusions
funny	grades	hardest	holes	incoming
furnace	grease	harm	homes	incorrect
fuse	greaser	haul	hooked	increases
fused	greatest	hazard	hopper	indicate
fuses	grind	hearing	horizontal*	indicates
fusion*	grinders	hearth	horrible	indicating
gage	grinding	heat*	horsepower	indication
galvanized	grip	heated	horses	induce
gap	gripe	heating	horseshoe	inductor
gas*	grooved	heavier	hose*	inherent
gases	grounded	helium	hoses	initial
gasfed	grounding	helper	hotter	initiates
gauge	guards	helpful	hottest	inner
gauges*	guess	hibond	household	innovation
generated	guests	highcarbon	hydrogen	input
generator*	guide	highest	identical	inspect
generators*	gypsy	highly	identification	inspected
gets	halfway	highpressure	ignite	inspection
giving	hammer	highspeed	immediately	installation
glad	handier	highstrength	impossible	instance
glare	handle	hissing	improperly	instant
glove	handled	Hobart	impurities	instructor

insulation	keeper	leaves	located	manufacture
insulator	keeps	leaving	locations	match
insure	key	lecture	looks	matches
intend	kicks	leg	loose	materials
intended	killed	legs	looseleaf	max
intense	kindling	lenses	lose	maximum
intensity	kinds	lesser	loss	meant
interchange	kink	lever	losses	measure
intercom	kitchen	leverage	loud	measured
intermittent	knob	lie	lying	measurement
interrupted	knobs	lighted	machinable	measuring
invented	label	lighter	machine	mechanical
invention	laboratory	lighters	machined	mechanism
involves	ladder	lighting	machines	medium
ionizes	laid	lightly	magical	melt
iron*	lamp*	lights	magnesium	melted
items	lamps	lightweight	magnet*	melting
janitor	lap	limit	magnetic*	melts
jarred	largely	limits	magnetism	mention
jarring	latent	lips	magnetized	mercury
jobs	layer	liquifying	magnets	metal*
join	laying	lists	mainly	metals
joined	leak	litre	maintained	meter*
joining	leakage	load*	maintenance	meters
joint*	leaking	loader	maltese	metre
joints*	leaks	loading	manganese	metric
joker	learn	loads	manually	microampere

microphone
microwire
mild
millimeter
milling
minded
mine
mini
minute
mishandled
mistake
mix
mixed
model
moderately
modernized
modify
molecules
molten
momentary
momentum
motion
motor*
motors
mounted
movable
multiple
multiples
named
names
narrow
naturally
nearby
neat
negative
neutral*
nine
nineteens
ninety
nipple
nipples
nobody
noise
nonburnable
nondestruct
nonferrous
nonpressure
notice
nozzle
nut
obtain
occupation
occur
occurs
odorless
offers
oil*
oily
openings
operate
operated
operating
operations
operator
opposite
ordinarily
ordinary
ore
orifice
original
otherwise
ourself
ourselves
outlet
outlets
output
outstripped
oval
overall
overhead
overheat
overheating
overmatch
overseas
owes
oxidation
oxides
oxidize
oxidized
oxyacetylene
oxygen*
o'clock
pain
painful
pairs
panel
parallel
pardon
park
partially
particles
partner
pass*
passes
passing
patch
path
peculiar
pencils
penetrate
penetrating
penetration*
percent
perform
performed
permanent
permit
permits
personally
phase
phases
phone*
physically
pick
picker
pickup
pictures
pieces
pig
pin
pink
pinpoint
pipe*
pipes

pitched
pivots
places
planned
plate*
plates*
played
playing
please
plenty
plug
plugs
plus
pocket
pocketed
pockets
pointed
poisonous
polarity*
pole*
poles
pop
popularity
porcelain
porosity
portable
positioned
positions
positive
possibility
pot
potential
pound
pounds
pour
practice
precarious
preceding
preferable
preference
preferred
preheat
preheating
preheats
preionizes
preparation
prepared
presents
pressures
prevent
prevented
prevents
primarily
primary
principal
procedure
proceed
processes
prod
produce*
produced*
produces
progressive
projection
prone
proper
properly
properties*
proportion
protect
protected
protection
protective
proud
provides
publication
puddle*
pull
pulled
pumps
purchased
pure
purify
purity
purposes
push
putting
qualified
quarterhorse
quick
quickly
quieter
quit
quizzes
rag
rags
raise
ranging
rapid
rapidity
rapidly
rated
readily
realize
rebuilt
receive
recommended
recorder
recorders
recovering
rectangular
reduce
reduced
reels
refer
reference
refers
refrigerate
registration
regular
regulator
regulators
reinforcement
relationship
relatively
related
relight
relighting
relying
removable
remove
removed
repair
repaired
repelling

replaced	rolling	screw	shielded	sizes
require	roof	screwed	shielding	skin
requirement	root*	seamless	shipping	slag
requires	rotating	seat	shipyard	slagging
reset	rotation	seconds	shock*	slight
resin	rough	secured	shocked	slightly
resistance*	route	security	shop	slip
resists	rpm	seldom	shower	slipperage
respiration	rub	select	shows*	slow
respirator	rubber	self	shrill	slower
rested	rugged	semester	shrinkage	smaller
restrooms	ruin	semiautomate	shunt*	smoke
resulting	rules	send	shunts	smooth
reverse*	rust	separate	shut	snap
reversed	safely	separation	sides	socket
reversible	safety	setting	sign	sockets
reversing	sampling	settle	signed	soft
review	sandwich	settling	silicon	soldering
revolunteer	satisfied	seventeen	sill	solid
rich	satisfies	seventy*	silly	solids
ricochet	saturated	severe	sink	somehow
rid	saves	sewing	sister	someone
ring	scale	shape	sit	somewhere
rivet	scarfing	shapes	sits	sons
rod*	scattered	sharp	sitting	soot
rods	scrap	sheet	situations	sorter
roll	scratched	shield	sixty*	source

spacing
sparks
spatter
specially
specification
specified
specify
specking
specks
speech
speed*
speeds
spell
spin
spitting
splice
spliced
splicer
splices
spontaneous
spot
squeal
squealing
stability
stabilization
stable
stainless
stairway
stall
stamped
stamps
standing
starter
starters
starting*
starts
stayed
steady
steel*
steels
stereo
stick
sticking
stopping
stops
storage
store
stored
stores
storing
straighten
strange
stream
strengths
strictly
striking
string
stringer
strip
strips
strongest
strongly
structural
struggling
strung
stuff*
stutter
subjected
submerged
submerging
substitute
suburb
success
suffix
suitable
supplier
suppliers
supplies
supply
suppose
supposed*
surfaces
surfacing
surge
surprises
surrounded
suspect
suspended
sweat
swimming
swinging
switch*
switches*
symbol
symbols
synchronous
tack
tacking
tags
tail
takes
tale
talking
tank
tanks
tape*
taps
tasteless
taut
tearing
technically
technique
tee
telephone
telling
tempt
tend
tendency
tends
tens
tensile
tension
terminal
terminals
terminated
terribly
testing
thermal
thick
thicker
thickness
thicknesses
thin
thirds
thirteen*

thirteens
thirty*
thorough
threads
throw
tight
tilt
tinning
tip*
tips*
tonight
tool
tools
torch*
torches
touch
touchdown
touching
tough
towards
track
transfer
transferred
transmit
transmitted
transport
travel*
trigger
trimmer
truck
trucks
tube
tubes
tubing
Tuesday
tulips
tungsten
turning
turns
twelve
twentieth
twenty
twice
twisted
twists
typically
unbroken
unconstitute
undercutting
underneath
undesirable
uneven
unfortunate
unit*
units
unless
unnecessary
unstable
unusual
upright
upstairs
upstanding
usability
uses
utility
valve*
valves
variances
varied
varies
variety
vary
varying
vectors
vee
ventilation
version
vertical
vice
views
violent
visible
volt
voltage*
volts
wait
wanting
wants
washed
washing
watch
watt
watts
weakened
wear
weaved
weight
weld*
welded*
welder
welders
welding*
welds
wet
wheels
whenever
whipping
widely
wider
wind
windy
wipe
wire*
wires
wiring
wonders
worker
workpiece
worn
wound
woven
wrapped
yelling
yourself
zero
zinc

APPENDIX B

HIGHEST FREQUENCY WORD LIST

The 100 words on the following page represented 45% of the words used in all the language sampled. This list is based on the combined oral and written language samples from all occupations studied. It shows the words used most frequently by adults in the ten jobs studied and in the vocational training programs corresponding to those jobs.

Total Words	=	180,000
Total Different Words	=	9,000

the	will	your	see
of	one	was	more
to	not	get	these
and	an	has	into
a	there	must	just
is	can	any	them
in	when	he	down
it	out	got	time
for	we	know	about
that	which	then	been
you	what	don't	some
be	do	each	business
or	up	air	how
on	pressure	check	its
are	two	that's	back
I	so	but	over
this	they	system	work
with	here	through	would
as	other	valve	temperature
by	ok	going	same
if	right	well	also
have	no	use	where
all	used	than	now
at	may	it's	only
from	should	go	like

APPENDIX C

SUMMARY OF OCCUPATIONAL LITERACY REQUIREMENTS

This appendix presents a brief summary of the literacy requirements for all ten occupations studied.

SUMMARY OF OCCUPATIONAL LITERACY REQUIREMENTS

	On The Job		Training Program	
	Reading	Mathematics	Reading	Mathematics
Account Clerk	College to college graduate level	addition, subtraction, multiplication, division, decimals, fractions, business machines	11th grade to college graduate	addition, subtraction, multiplication, division, fractions, decimals. algebra
Automotive Mechanic	9th to college graduate level	basic processes, decimals, fractions, measurement	9th to college graduate level	basic processes, decimals, fractions, measurement
Draftsman	10th grade to college graduate	basic processes, through geometry, algebra, trigonometry	9th grade to college level	basic processes, through geometry, algebra, trigonometry
Electrician	college to college graduate level	basic processes, throguh geometry, algebra, trigonometry	10th grade to college graduate level	basic processes, through geometry, algebra, trigonometry
Heating and Air conditioning Mechanic	10th grade to college graduate level	basic processes, decimals, fractions, measurement, algebra	11th grade to college graduate level	basic processes, fractions, decimals, measurement
Industrial Maintenance Mechanic	10th grade to college graduate level	basic processes through trigonometry	10th grade to college graduate level	basic processes, decimals, fractions, measurement
Licensed Practical Nurse	10th grade to college level	addition, and subtraction--more necessary to dispense medication	12th grade to college graduate level	addition and subtraction
Machine Tool Operator	9th to college graduate	basic processes, decimals, measurement	9th grade to college level	basic processes, decimals, measurement
Secretary	College to college graduate level	basic processes, decimals, fractions, business machines	10th grade to college level	basic processes, decimals, business machines
Welder	few materials--reading of single word information required	basic processes, fractions, decimals, measurement	8th grade to college graduate level	basic processes, fractions, decimals, measurement, algebra